TAP 408-1: Field strength

Data required:

$k = 1/(4\pi\varepsilon_0) = 9.0 \times 10^9$ N m^2 C^{-2}

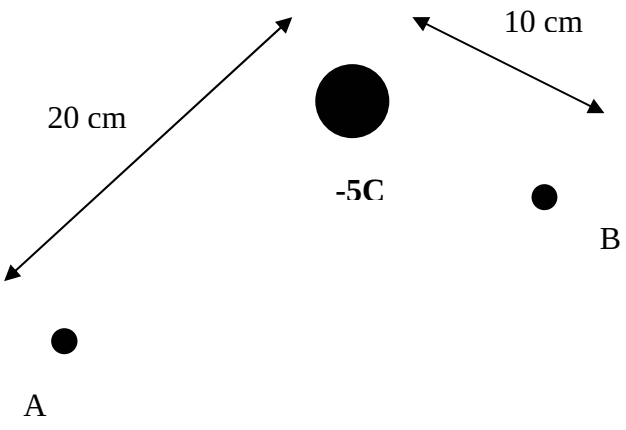
charge of electron = 1.6×10^{-19} C

1) Where the field strength is 1000 N C^{-1}, what is the force on a 1 C charge? On an electron?

2) A charged sphere is placed in a field of strength 3×10^4 N C^{-1}. If it experiences a force of 15 N, what is the charge on the sphere?

3) What is the field strength if an electron experiances a force of 4.8×10^{-14} N?

4) Work out the field strengths at the points labelled A and B in the diagram below. What do you notice about the values, and why is this? Add arrows at A and B to indicate the electric field strengths there.



Practical advice

These can be used as worked examples or student problems

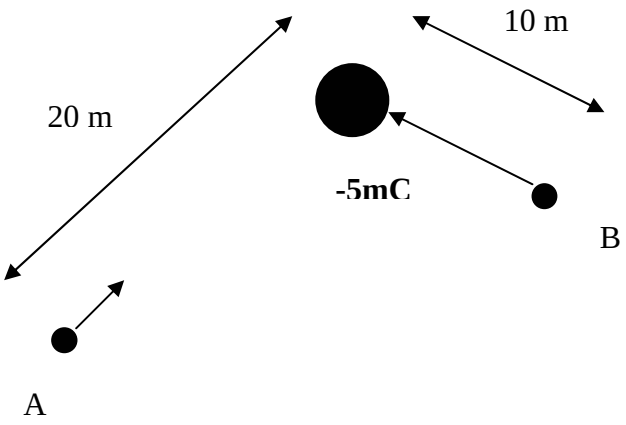
Answers and worked solutions

1) $F = EQ = 1000 \times 1 = 1000N$ $F = EQ = 1000 \times 1.6 \times 10^{-19} = 1.6 \times 10^{-16}$ N

2) $Q = F/E = 15 / (3 \times 10^{4}) = 5 \times 10^{-4}$ C or 0.5 mC.

$3E = F/Q = 4.8 \times 10^{-14} / (1.6 \times 10^{-19}) = 3 \times 10^{5}$ N C^{-1}

4)



$E_A = kQ/r^2 = 9.0 \times 10^{9} \times -5 \times 10^{-3} / 20^2 = -1.125 \times 10^{5}$ N C^{-1}

$E_B = kQ/r^2 = 9.0 \times 10^{9} \times -5 \times 10^{-3} / 10^2 = -4.5 \times 10^{5}$ N C^{-1}

The negative signs are there simply because the charge creating the field is negative (they are actually from the more precise vector equation for field strength).

The directions of the field are given on the diagram above.